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THE EKATERINBURG SEMINAR "ALGEBRAIC SYSTEMS": 50 YEARS OF ACTIVITIES

Lev N. Shevrin

Ural Federal University, Ekaterinburg, Russia,
lev.shevrin@urfu.ru

Abstract: The aim of the present article is to give a characterization of distinctive features of the scientific seminar founded and led by the author as well as to show the main sides of its activities during half a century.

Key words: algebraic systems, Ekaterinburg seminar, sides of activities.

1. Introducing remarks

The seminar indicated in the title of the article started its work in 1966. By that time several younger researchers had been grouped around the present writer at Ural State University. Naturally, I discussed with each of them different problems pertaining to the area of his/her research. However, besides these individual meetings, the natural need had arisen to gather regularly and to discuss the results obtained as well as diverse problems concerning our investigations in algebra.

It should be noted that Ekaterinburg (Sverdlovsk from 1924 till 1991) is a city with considerable scientific algebraic traditions. In a great degree the beginning of algebraic studies there was owing to the activities of Professor P. G. Kontorovich (1905–1968) who worked for several decades at Ural State University and was one of the leading Soviet algebraists. The scientific school created by P. G. Kontorovich gained notable recognition in mathematical community by the 1960s, and, in particular, it was not accidental that, after the first two All-Union Algebraic Conferences held in Moscow in 1958 and 1959, the third one was organized in Sverdlovsk in 1960, and Prof. Kontorovich was the Chairman of its Organizing Committee[1]. My scientific rise began under Kontorovich's supervision; I defended a dissertation for "Candidate of Sciences" degree in 1961 and a dissertation for "Doctor of Sciences" degree in 1966[2].

The seminar, which afterwards received the name "Algebraic Systems", had at first about 10 members. Since the 1970s the number of its regular participants remains at the level about 20, although in the 1980s it sometimes achieved up to 25–30 persons. Since the middle of the 1980s, side by side with students of the leader of the seminar, students of my students were becoming regular participants in the seminar. The number of such "scientific grandchildren" is steadily increasing; moreover, now there are already more than ten scientific great-grandchildren of mine.

[1]In the paper [1], I have written rather minutely about the formation of the Sverdlovsk algebraic school for the period from the end of the 1930s till the beginning of the 1960s, where some key figures were presented and some essential events and facts were mentioned. The articles [2] and [3] are devoted personally to P. G. Kontorovich. They are published in a special issue of the journal "Izvestiya Ural'skogo gosudarstvennogo universiteta" dedicated to the centenary of his birthday; the second of them is reproduced from an issue of "Matematicheskie zapiski" (Mathematical Transactions) of Ural State University (1970) dedicated to the memory of Kontorovich.

[2]For a foreign reader who may not be familiar with the system of Soviet (and now Russian) scientific degrees, I note that Candidate of Sciences approximately corresponds to Ph.D. in the Western World, while Doctor of Sciences is a considerably higher scientific degree.

Besides discussing problems and results, it became traditional for the seminar to discuss also abstracts of talks being prepared for various conferences. Furthermore, it became customary when the members of the seminar attended some conferences report at the seminar about these conferences. The leader of the seminar pays much attention to the development of disciples' skill in performing scientific talks and writing mathematical works.

Soon enough, since 1969, algebraists from other towns of the former Soviet Union began to appear as the speakers at our seminar; this takes place up to now more or less regularly. Since 1989 foreign speakers appear from time to time as well.

For half a century the community of regular participants in the seminar in different years got significant achievements, both in research and educational spheres as well as in various forms of scientific-organizing activities. So a natural desire has arisen to display a general picture of distinctive features of the seminar and to show these achievements. The aim of this article is to present such a picture. Sections 2–8 are devoted to the following its aspects: *topics and some peculiarities in research, dissertations, grants, publications, participation in conferences, organization of conferences, membership in editorial boards*; some information concerning meetings and speakers at the seminar is given in Section 9.

It should be noted that the first rather detailed information about this seminar in some publication was given in 1998 in [4]. As to the present article, it is an enlarged (and slightly revised) version of the article [5] placed in 2007 on the website of the European Academy of Sciences. I am grateful to Mikhail Volkov, Boris Vernikov, and Arseny Shur for their help in collecting the data concerning the last decade for this version.

2. Topics and some peculiarities in research

The objects of investigations carrying out at the seminar are a number of the main types of algebraic systems: semigroups, groups, rings and algebras (both associative and non-associative, in particular, Lie algebras), lattices, and some others. These types of systems are subjects of largely developed theories, which continue to develop intensively. The members of the seminar succeeded in fundamental contributing to several branches of these theories; it will be briefly characterized below. Since the 1990s the area of our interests had been broadened and began including some topics that it is customary to refer as belonging to discrete mathematics. I mention among them, first of all, certain problems of the theories of graphs and clones, in particular, problems of discrete optimization. Since the end of the last century considerable attention has been given to applied aspects of algebra, see item (x) below and item g) at the end of this section. One may distinguish the following main lines of our investigations (with a different degree of intensity in different periods of our work).

(i) Structure of systems and finiteness conditions[3].

(ii) Lattices properties, i.e. properties connected with considering lattices of subsystems for systems of a given class.

[3]Here it is, of course, impossible to give definitions for the main notions being mentioned. However, in some exclusive cases one may formulate definitions that can be understandable even for the reader who is not an algebraist. For instance, it concerns the notion "finiteness condition". Given a class of algebraic systems, by a *finiteness condition* is meant any property which is possessed by all finite systems of this class. Many infinite systems satisfy certain finiteness conditions, and investigation of systems with such conditions provides a possibility to obtain diverse results in much more general situations than for finite systems. Imposing finiteness conditions is a classical approach (within the 20th century) in investigations of algebraic systems of different kinds. For the reader who would like to consult some source with other algebraic notions mentioned in this article, I may recommend the handbook [6] (in Russian) or the handbook [7] (in English).

(iii) Varieties and similar classes: quasivarieties, pseudovarieties, and the like.
(iv) Algorithmic problems.
(v) Congruences.
(vi) Embeddings.
(vii) Transformations.
(viii) Independence of related structures: automorphism group, congruence lattice, subsystem lattice, etc.
(ix) Combinatorics, graph theory, and discrete optimization.
(x) Applications of an algebraic approach to some branches of computer science: computational complexity, synchronizability of finite automata, various problems for formal languages, etc.

In each of these lines, there are many essential results obtained by the members of the seminar. The most notable achievements, especially for the first four decades of our activity, concern lines (i)–(iv) which we accomplished quite a number of major series of works in. They have gained considerable recognition, which is reflected, in particular, in some summarizing publications at an international level, see Section 5 below.

I would like to give some comments for line (iii). The central concept here is a variety. A class of algebraic systems is called a *variety* if there is a set of identities such that this class consists of all systems satisfying all identities from this set. Development of the theory of varieties started in 1935 by a basic paper by G. Birkhoff. At the second half of the 20th century the theory of varieties became one of the main lines in general algebra. Plenty of investigations were devoted to this theory in many countries. In our seminar, such investigations had been begun since the end of the 1960s. They may be (conditionally) divided into five topics: identities, structural aspects, lattices of varieties, free systems, and algorithmic problems. In each of them, certain concrete parts may be distinguished. For instance, for the topic "identities", one of the central problems, called the *finite basis problem*, is to determine which varieties can be given by a finite set of identities. Some fundamental results obtained by several members of the seminar were devoted just to this problem for different classes of algebraic systems, to the problem of classification of varieties with certain restrictions on the lattice of subvarieties, to description of varieties whose elementary theory is decidable as well as to quite a number of other important problems.

The concept of a quasivariety is a certain generalization of the concept of a variety, the concept of a pseudovariety is an analogue of the concept of variety as applied to finite systems. Both these concepts also serve as the objects of fruitful investigations. A motivation for the study of pseudovarieties is caused in a great degree by deep connections between pseudovarieties and formal languages. A key impulse for the development in this direction was given by S. Eilenberg (1976) in the volume B of his well-known monograph "Automata, Languages and Machines".

The classification (i)–(x) is rather conditional: there are no clear-cut borders between these lines. Moreover, for the themes of many works accomplished at the seminar, it is just typical to combine idea motifs pertained to two or more lines. Examples of such interlacing are numerous, and there is no reason to try characterizing all corresponding situations within this article. I will touch only on one of subject lines — imposing finiteness conditions. This classical approach was applied in our research in diverse situations: in study of lattice properties of semigroups and groups; in considerations of congruences (for instance, in study of residually finite semigroups and rings, in particular, from the view of the theory of varieties); in a combination with problems of embeddings (a typical example is a search of conditions for embeddability in finitely generated systems with certain restrictions) as well as in investigations on algorithmic problems (for instance, in those cases when the main objects of attention are finitely presented systems).

One may note several specific features of research at the seminar.

a) *Predominance of semigroups*, especially during the first three decades of the seminar work. It is worth noticing in this connection that the theory of semigroups is one of the youngest fields of modern algebra. It had been formed by the 1960s, just then the first monographs appeared that were entirely devoted to semigroups: the book "*Semigroups*" by E. S. Ljapin in Soviet Union (1960) and two volumes of the classical monograph "*The Algebraic Theory of Semigroups*" in USA by A. H. Clifford and G. B. Preston (1961, 1967). As it can be seen from relevant information in item f) of this section and in Sections 3–8, diverse manifestations of our activities in semigroup theory are numerous.

b) At the same time, *dissemination of our interests and research to other types of algebraic systems*. See, in particular, comments given in item c) and especially in item f) containing a more concrete assertion that will be illustrated in the subsequent text of that paragraph. This illustration, together with information given in Sections 3–5, allows showing more minutely various subjects of research accomplished at the seminar.

c) *Permanent attention to lattices*, both as an independent type of systems and (mostly) as related structures: the lattices of subsystems, of congruences, of ideals, of clones, of subvarieties, of subquasivarieties, of subpseudovarieties, and the like.

d) In general, *attention to related structures of different kinds*: automorphism groups, endomorphism monoids, elementary theories, and the like.

e) *Permanent attention to algorithmic problems.*

f) During the first 3 decades of activities of the seminar, *investigations of the same problem for different types of algebraic systems*, both owing to research pursuing by different authors and in works carried out by one and the same author.

Here is a list of the themes of such "polysystem" series of works, each one due to the same author.

- Densely embedded ideals of semigroups, associative algebras (as well as some generalizations), and Lie algebras, by *L. N. Shevrin*, the 1960s – the beginning of the 1970s.
- Decidability of elementary theories of varieties of groups, semigroups, and associative rings, by *A. P. Zamyatin*, the 1970s.
- Independence of related structures for semigroups and lattices, by *V. A. Baransky*, the 1970s–1980s.
- Attainability and solvability for classes of algebras as applied to arbitrary universal algebras, semigroups, groups, modules, associative and Lie algebras, and unars, by *L. M. Martynov*, the 1970s–1980s.
- Bases of identities and lattices of varieties applied to associative rings and semigroups, by *M. V. Volkov*, the end of the 1970s – the beginning of the 1990s.
- Critical theories of certain classes of semigroups and rings, by *Yu. M. Vazhenin*, the 1980s – the beginning of the 1990s.
- The word problem for varieties of groups and Lie algebras, by *O. G. Kharlampovich*, the 1980s.
- Algorithmic problems for semigroups and associative algebras, by *M. V. Sapir*, the 1980s.
- Radicals and bands of semigroups and associative rings, by *A. V. Kelarev*, the 1980s.
- Lattices of varieties of associative rings and semigroups, by *B. M. Vernikov*, the 1980s.
- Representation of lattices by subsystem lattices as applied to semigroups, groups, rings, and lattices, by *V. B. Repnitskiĭ*, the end of the 1980s – the 1990s.
- Algorithmic problems for varieties of semigroups, monoids, groups, and rings, by

V. Yu. Popov, the 1990s – the beginning of the 2000s.

g) In the 21st century, *increased attention to using an algebraic approach in some related fields of mathematics, first of all in computer science.* As a result, the following topics have become rather typical for our investigations accomplished in the years of this century: algebraic theory of formal languages and automata, diverse problems concerning computational complexity (in particular, as applied to bioinformatics), extremal problems on graphs and working out effective algorithms for solution of them, intelligent systems and robotics. Some details of this trend can be observed in formulations of the subjects of relevant dissertations and grants (see Sections 3 and 4) as well as in the themes of three conferences held in Ekaterinburg since 2007 (see corresponding information in Section 7). I notice that a remote portent of these conferences was the Regional Conference of Young Scientists held in Sverdlovsk in 1982 (see its name in Section 7). Organization of the mentioned three conferences in Ekaterinburg may serve as one of the signs showing that our achievements in respective branches also, as properly algebraic ones, have received international recognition.

3. Dissertations

The results of our investigations have found a natural reflection in dissertations defended by the members of the seminar. By 2017 there have been 95 such dissertations in all, among them 81 for Candidate Degree and 14 for Doctor Degree.

I give below the list of all these dissertations. The components of this list concerning Candidate dissertations are ordered by the starting years for the corresponding supervisors and, within the group of dissertations with the same supervisor, chronologically by the dates of defences. As to Doctoral dissertations, they are ordered chronologically.

3.1. Candidate dissertations

Supervisor L. N. Shevrin:

1. *N. D. Filippov.* Partially ordered sets and certain algebraic systems connected with them, 1969.
2. *E. A. Golubov.* Finitely separable and residually finite semigroups, 1970.
3. *V. A. Baransky.* Lattice isomorphisms of semigroups, and certain semigroup-theoretic constructions, 1971.
4. *Yu. M. Vazhenin.* Semigroups of transformations of graphs, and the first order language, 1972.
5. *L. M. Martynov.* Verbal chains in universal algebras, 1972.
6. *A. N. Trakhtman.* On the system of proper subsemigroups of a semigroup, 1973.
7. *T. I. Ershova.* On lattice properties of inverse semigroups, 1974.
8. *A. S. Prosvirov.* Idealizers of subsemigroups, and the structure of a semigroup, 1977.
9. *V. B. Lender.* The operation of multipication on classes of lattices, and related topics, 1977.
10. *A. M. Gasanov.* Ternary semigroups of continuous and homeomorphic mappings, 1978.
11. *A. P. Zamyatin.* Decidability of elementary theories of varieties of groups, semigroups, and associative rings, 1979.
12. *V. N. Klimov.* Congruences of semigroups, 1979.
13. *A. J. Ovsyannikov.* Lattice isomorphisms of semigroups, and varieties of semigroups, 1980.
14. *M. V. Volkov.* Lattices of varieties of rings, 1980.

15. *B. P. Tanana.* On lattice properties of topological semigroups, 1980.
16. *E. V. Sukhanov.* Varieties and bands of semigroups, 1980.
17. *E. I. Kleiman.* Varieties of inverse semigroups, 1981.
18. *O. M. Mamedov.* Equational compactness in general algebras and algebras with an order relation, 1982.
19. *V. V. Rasin.* Varieties of Clifford semigroups, 1982.
20. *M. V. Sapir.* Quasivarieties of semigroups, 1983.
21. *S. I. Katsman.* Semigroups with certain types of subsemigroup lattices, 1983.
22. *T. A. Martynova.* The groupoid of varieties of semigroups with zero, 1983.
23. *O. G. Kharlampovich.* Algorithmic and other combinatorial problems for groups and Lie algebras, 1984.
24. *V. B. Repnitskiĭ.* Varieties of lattice-ordered semigroups, 1985.
25. *I. O. Koryakov.* Periodic linear semigroups, 1985.
26. *E. A. Perminov.* Rigid graphs and lattices, 1985.
27. *B. V. Rozenblat.* On elementary and positive theories of relatively free semigroups, 1985.
28. *A. N. Petrov.* Embeddings of semigroups, and varieties, 1987.
29. *A. V. Kelarev.* Radicals and bands of semigroups and associative rings, 1989.
30. *B. M. Vernikov.* Varieties of associative rings and semigroups with restrictions on the subvariety lattice, 1989.
31. *O. V. Knyazev.* On the theory of varieties of Clifford semigroups, 1991.

Supervisor V. A. Baransky:

1. *P. V. Shumyatsky.* Periodic groups whose automorphism groups are regular 2-groups, 1989.
2. *A. P. Zolotarev.* Helly, Radon, Caratheodory, and Goldi numbers in lattices, 1993.
3. *V. A. Shcherbakova.* The Steiner problem on a graduated directed graph, 1998.
4. *O. V. Rasin.* Polynomial algorithms of recognition of isomorphism in some classes of graphs, 2005.
5. *L. M. Volkov.* Models and algorithms of information handling in program complexes of electronic documents-circulation, 2006.
6. *T. A. Koroleva.* Lattices of integral partitions, and chromatically uniqueness of graphs, 2008.
7. *M. I. Naumik.* Congruences of the semigroup of linear relations, 2008.
8. *S. N. Pupyrev.* Models, algorithms, and a program complex for visualizing complex networks, 2010.
9. *T. A. Senchonok.* Classification and determinability of elements of small height in the lattices of complete multipartite graphs, 2012.
10. *O. E. Perminova.* Critical lattices, 2014.

Supervisor Yu. M. Vazhenin:

1. *S. V. Sizyi.* Quazivarieties of endomodels, and algorithmic problems,1990.
2. *B. Bayasgalan.* Decidable theories of related structures of semigroups, 1991.
3. *V. Yu. Popov.* Critical theories of varieties of rings, 1995.
4. *Yu. V. Nagrebetskaya.* Decidability of theories of the first order of matrix algebras and groups of transformations, 2000.

Supervisor E. V. Sukhanov:

1. *A. A. Bulatov.* Algebraic properties of the lattice of clones, 1995.
2. *A. M. Shur.* Algebraic and combinatorial properties of equational languages, 1998.
3. *A. A. Krokhin.* Intervals in lattices of clones, 1998.
4. *K. L. Safin.* Ideals of iterative algebras, 2000.
5. *A. P. Semigrodskikh.* Lattices of closed classes of functions on an infinite set, 2003.
6. *A. V. Klepinin.* On algebraic and applied aspects of the problem of search of information, 2005.

Supervisor M. V. Volkov:

1. *D. S. Ananichev.* Identities in the lattices of varieties of solvable Lie rings, 1997.
2. *O. B. Finogenova (Paison).* Indicator characterizations of certain properties of varieties of associative rings, 1998.
3. *I. A. Goldberg.* The finite basis problem for semigroups of transformations, 2006.
4. *G. V. Tanana.* Structural and equational properties of adjoint regular rings, 2007.
5. *V. S. Grishchenko.* Metrics of reputation: models and algorithms of construction of open information environments, 2007.
6. *S. V. Goldberg (Pleshcheva).* Complexity of the identity checking problem in finite semigroups, 2008.
7. *E. S. Skvortsov.* On effective algorithms for the problem CSP, and a program realization of them, 2008.
8. *E. V. Pribavkina.* Problems of optimality in the theory of synchronizing automata, 2009.
9. *G. A. Povarov.* Descriptive complexity of certain transformations of regular languages, 2010.
10. *I. A. Mikhailova.* Patterns being avoided by antichains of words, and algebraic applications of them, 2010.
11. *M. V. Berlinkov.* Approximating the lengths of synchronizing words for finite automata, 2011.
12. *Yu. I. Zaks.* Synchronizability of finite automata in extremal and mean cases, 2012.
13. *V. V. Gusev.* Extremal constructions in the theory of synchronizing automata, 2013.
14. *T. V. Pervukhina.* Varieties and pseudovarieties of semigroups of triangular matrices, 2014.
15. *M. I. Maslennikova.* Ideal languages and synchronizing automata, 2015.

Supervisor I. O. Koryakov:

1. *I. Yu. Zhil'tsov.* Pseudo-operations and pseudo-free semigroups, 1999.

Supervisor A. M. Shur:

1. *Yu. V. Gamzova.* Combinatorial properties of partial words (co-supervisor E. V. Sukhanov), 2006.
2. *A. N. Plyushchenko.* On combinatorial properties of Burnside semigroups, 2012.
3. *I. A. Gorbunova.* Constructing and enumerating extremal power-free words, and an estimate of the quantity of them, 2013.
4. *E. A. Petrova.* On combinatorial properties of power-free languages, 2016.
5. *M. V. Rubinchik.* Computational complexity of certain problems of string processing, 2016.

6. *D. A. Kosolobov.* Efficient algorithms for studying regularities in strings, 2016.

Supervisor D. S. Ananichev:

1. *P. V. Martyugin.* Bounds for the length and computational complexity of synchronization of finite automata, 2008.
2. *I. V. Petrov.* Universal synchronizing and universal collapsing words, 2009.

Supervisor V. Yu. Popov:

1. *Yu. S. Okulovsky.* A program complex for software of intelligent computations, 2009.
2. *A. A. Gorbenko.* Methods of combinatorial virtualization for mobile robots, 2014.
3. *A. S. Sheka.* Models, algorithms, and a program complex for software of intelligent experiment, 2014.

Supervisor S. V. Sizyi:

1. *E. A. Rogozinnikov.* Groups of transformations of curves, 2014.

Supervisor B. M. Vernikov:

1. *V. Yu. Shaprynskiĭ.* Special elements of lattices of semigroup varieties, 2015.
2. *D. V. Skokov.* Identities and special elements in the lattice of varieties of epigroups, 2016.

3.2. Doctoral dissertations

For such dissertations, as it is known, a person whose role is similar to that of a supervisor is called a scientific consultant. In cases 2–8 and 10–12, the scientific consultant was L. N. Shevrin, in cases 9 and 14 they were, respectively, Yu. M. Vazhenin and M. V. Volkov. Case 13 is unordinary: this is a dissertation for a scientific degree "Doctor of Engineering Sciences", and the scientific consultant was Prof. V. M. Saĭ, a specialist in certain topics pertaining to railway transport, who originally asked to help him in application of some mathematical methods in the problems that he considered. S. V. Sizyi responded to that request and, as a result, had involved in these problems, what ultimately led to his own achievements in the area considered. His dissertation is obviously far from algebra, but the author used a number of methods of related fields of mathematics: discrete mathematics, graph theory, probability theory, mathematical statistics, and the like.

1. *L. N. Shevrin.* Lattice properties of semigroups, 1966.
2. *V. A. Baransky.* Independence of related structures in classes of algebraic systems, 1987.
3. *O. G. Kharlampovich.* Word problem for groups and Lie algebras, 1990.
4. *Yu. M. Vazhenin.* Critical theories of the first order, 1992.
5. *L. M. Martynov.* Spectra of solvability for varieties of algebras, 1992.
6. *M. V. Volkov.* Identities in lattices of varieties of semigroups, 1994.
7. *D. A. Bredikhin.* Identities and quasi-identities of relation algebras, 1997.
8. *V. B. Repnitskiĭ.* Representations of lattices by subalgebra lattices, 1997.
9. *V. Yu. Popov.* Algorithmic problems for varieties of semigroups, monoids, groups, and rings, 2002.
10. *B. M. Vernikov.* Identities and quasi-identities in lattices of varieties of semigroups, and congruences related to them, 2004.

11. *A. A. Bulatov.* Algebraic methods in investigation of combinatorial problems, 2008.
12. *A. M. Shur.* Combinatorial characterization of formal languages, 2010.
13. *S. V. Sizyi.* Theory and methodology of formation of netting-organizational co-ordination on railway transport, 2011.
14. *O. B. Finogenova.* Properties of varieties of associative algebras given in a language of derived objects: indicator and equational characterizations, 2016.

In conclusion of this section, I would like to note that several former members of the seminar now work in other towns, mostly abroad. Some of them trained their own students who defended dissertations. They are the following persons; for each one, I give the number of dissertations for which he/she was the supervisor: L. M. Martynov (Omsk, Russia) – 3, M. V. Sapir (Nashville, USA) – 5, O. G. Kharlampovich (Montreal, Canada, later New York, USA) – 9, A. V. Kelarev (Hobart, Australia) – 2, P. V. Shumyatsky (Brasilia, Brazil) – 9, B. P. Tanana (Maputo, Mozambique) – 1, A. A. Bulatov (Vancouver, Canada) – 1, Krokhin (Durham, Great Britain) – 1.

From information given above it follows that by 2017 there are in all 113 disciples with scientific degrees in the "scientific tree" of the leader of the seminar. The number of persons in this tree will definitely increase for the near years: now there are fairly many post-graduated students who are doing research under supervision of some elder members of the seminar.

4. Grants

The subjects of our research are also reflected in the grants we had from sources both national and international. Note that in Russia a system of scientific grants was established only since the beginning of the 1990s. I give below a list of grants got by some, as a rule, small teams of researchers belonging to the seminar and point out, in the chronological order within a group of grants with the same distributor, i) the structures that distributed grants, ii) the research subjects of grants, iii) for each grant, the leader (the only researcher or one of the members of an international team of researches, if it is specially pointed out), and iv) the years of supporting.

State Committee of Higher Education (later Ministry of Education)

- Pseudovarieties of algebras: combinatorial-algebraic aspects, *Shevrin*, 1994–1995.
- Pseudovarieties: algorithmic and structural-topological aspects, *Shevrin*, 1996–1997.
- Combinatorial-algebraic properties of logical functions and formal languages, *Sukhanov*, 1996–1997.
- Combinatorial-algebraic aspects of the theory of logical functions and formal languages, *Sukhanov*, 1998–2000.
- New approaches in the theory of pseudovarieties of semigroups, *Shevrin*, 1998–2000.
- Pseudovarieties of semigroups, and their applications in computer science, *Shevrin*, 2001–2002.
- Profinite methods in the theory of pseudovarieties and symbolic dynamics, *Shevrin*, 2003–2004.

International Science Foundation

- Semigroup varieties: their lattices and free objects, *Shevrin*, 1994–1995.

The International Association for the promotion of cooperation with scientists from the New Independent States of the former Soviet Union (INTAS).

- Algebraic and logic models for computer science, *one of the researchers Volkov*, 1995–1996.
- Combinatorial and geometric theory of groups and semigroups, and its applications to computer science, *the coordinator of the Russian part of the project Volkov*, 2000–2003.
- Universal algebra and lattice theory, *one of the researchers Repnitskiĭ*, 2004–2006.

Ministry of Culture and Education of Hungary

- Semigroups and their classes, *one of the researchers Volkov*, 1997–2000.

Russian Foundation for Basic Research

- Idea of variety applied to finite and regular semigroups, *Shevrin*, 1997–1999.
- Lattices of varieties of classical algebras, *Volkov*, 2001–2003.
- Access control of information in computer systems, *Baransky*, 2003.
- Combinatorics on words and automata, and its applications in computer science and bioinformatics, *Volkov*, 2005–2007.
- Epigroups: structural and equational aspects, *Shevrin*, 2006–2008.
- Fundamental problems of the theory of algebraic systems, and applications in informatics, *Volkov*, 2009–2010.
- Lattice properties of semigroups and semigroup varieties, *Shevrin*, 2010–2012.
- Dynamics of finite automata and regular languages, *Volkov*, 2010–2012.
- Intelligent algorithms of planning, and correction of movement of a robot, *Okulovsky*, 2013.
- New aspects in dynamics of finite automata and symbolic sequences, *Volkov*, 2013–2015.
- Investigation of algorithms for intelligent robotics complexes, *Popov*, 2013–2015.
- Selected aspects of structural and equational theory of semigroups, *Shevrin*, 2014–2016.

The scientific program "Universities of Russia"

- Subsystems and congruences of algebraic systems, *Shevrin*, 1994–1995.
- Lattices as related structures, *Shevrin*, 1998–2000.
- Structural and combinatorial properties of algebraic systems, *Shevrin*, 2002–2003.
- Structural and combinatorial theory of algebraic systems, and its applications, *Shevrin*, 2004.

Federal Agency of Russia on Science and Innovation (Rosnauka)

- Combinatorial characterizations of formal languages, *Shur*, 2006–2007.

A special Federal program "Scientific and scientific-educational specialists of innovative Russia"

- Intelligent algorithms of a calibration of robotics systems, *Okulovsky*, 2010.

The Ministry program of a support of post-graduate students

- The isomorphism problem for graphs, and dist-decompositions, *the researcher O. V. Rasin, the supervisor Baransky*, 2003–2004.
- The finite basis problem for some semigroups of transformations, *the researcher I. A. Goldberg, the supervisor Volkov*, 2004–2005.

Other projects of the Ministry of Education (or, later, of Education and Science)

- Combinatorial theory of varieties and pseudovarieties of semigroups, languages, and automata, and its applications in computer science and information security, *Shevrin*, 2003–2005.
- A new generation of a scientific school on algebra and discrete mathematics, *Shevrin*, 2005.
- Investigations on the theory of algebraic systems and its applications in computer science and bioinformatics, *Shevrin*, 2009–2011.
- Algebraic models of robotics systems, *Popov*, 2009–2011.
- Structural and combinatorial methods in the theory of algebraic systems, and its applications in computer science and bioinformatics, *Shevrin*, 2013.
- Combinatorial-logical methods in mathematical modeling and in computer science, *Volkov*, 2013.
- Intelligent systems of navigation and control for teams of autonomous mobile robots, *Popov*, 2012–2013.
- Structural and combinatorial methods of modern general algebra, *Vernikov*, 2014–2016.
- Applied aspects of combinatorial algebra: discrete modeling of informational and technological processes, *Volkov*, 2014–2016.

The President program of a support of young candidates of sciences

- Investigation of synchronizable finite automata and their generalizations, *the researcher Martyugin*, 2012–2013.
- Languages of synchronizing words of automata, and synchronizable colorings, *the researcher Pribavkina*, 2013–2015.

The President program of a support of young doctors of sciences

- Computational complexity of algorithmic problems, *the researcher Popov*, 2006–2007.
- Intelligent systems, high-performance computing, and computational complexity of algorithmic problems, *the researcher Popov*, 2008–2009.

The President program of a support of leading scientific schools of the Russian Federation

- Investigations of classical algebraic systems and algebraic methods in computer science, *Shevrin*, 2003–2005.
- Investigations on the theory of algebraic systems and its applications in computer science, *Shevrin*, 2014–2015.

These two grants, crowning the long sequence of our grants, have marked activities of the whole collective joined by the seminar "Algebraic Systems".

5. Publications

Taking into account a long life of the seminar and a great quantity of persons who participated in its work in different years, it is not easy to give absolute exact numbers of scientific works of diverse kinds published by these persons (although during the first years of the seminar we kept a precise account concerning this matter). Anyway, I may assert that there are definitely over 900

papers in all published by the members of the seminar, not counting many hundreds of abstracts of talks at various conferences[4].

The main summands of this number are the following: over 800 research papers including more than 300 papers published in the central Russian mathematical journals, more than 200 papers published in other publications in Russian (among them more than 110 ones in "Matematicheskie zapiski" of Ural State University, which were published annually in the 1960s–1980s), and more than 300 papers published in international journals or proceedings of international conferences; further, over 60 papers of encyclopaedic character published in three encyclopaedias, one encyclopaedic dictionary, and one handbook; over 30 papers of information character about conferences or other mathematical events, about mathematicians, and the like (some typical examples are represented by the papers [1]–[5]); several scientific-popular papers.

As to the books written by regular members of the seminar, there are three considerable monographs and one large book chapter as well as about hundred books of teaching character (textbooks and brochures) pertaining to both university and school education.

Certain details concerning this side of our activity are displayed below.

It is reasonable to point out first of all our summarizing works. These are the survey articles [8]–[28] and the monographs [29, 30]. One should add to this list the monograph [31]: its content includes a number of results obtained by the present or the former (as, first of all, its author) members of the seminar. Moreover, mentioning the book [31] in such a list is justified additionally by the fact that Volkov fruitfully contributed to creation of this monograph[5]. All these works are devoted to topics which particular attention was given to at the seminar, and where we made an appreciable (or, in some points, even a crucial) contribution. Note that the surveys [19] and [22] pertain to some topical trends concerning applications of an algebraic approach to computer science, which entered into a sphere of our interests since the very end of the 1990s. The first two authors of [19] are former members of the seminar, however in the year of this publication the second of them was still a regular member of it. I also note that the work on the surveys [13]–[15] was begun where their authors were among the regular members of the seminar.

The works listed, except the papers [16, 17, 23], and [26], are comprehensive and present in a systematical form achievements in the corresponding areas belonging not only to the members of the seminar but to many other authors. The first two of the papers just particularly noted give a survey of results in the theory of clones obtained by their authors (Sukhanov and his students) in the 1990s; the other two papers are based also on results obtained by their author. The short survey [26], motivated by a jubilee date related to S. N. Chernikov, draws a fragment of a wide picture presented with due completeness in Chapter IV of the monographs [29] and [30]. As to the paper [23], this 6-pages survey is in fact a very long abstract (almost the full text) of a plenary talk at an international conference. It contains, with thorough comments, 8 open problems posed by the author in different years. The first two of them concern nilsemigroups; they are connected:

[4]I emphasize that this and subsequent numbers concern publications which appeared when their authors were regular participants in the seminar. It is by no means that each of the mathematicians enumerated in Section 3 was a regular member of the seminar in some time. Moreover, some of them gave the only talk at the seminar, namely, a summarizing talk of a post-graduate student presenting his/her dissertation, while all previous talks of such students were given at the corresponding "subseminars" mentioned in Section 10. Furthermore, some regular members of the seminar once ceased attending it by one or another reason; in particular, this concerns those ones who left Ekaterinburg in their time. So the further works of such persons are not taken into account in reviews of our publications that we do once in a while, and, respectively, these data are not reflected in the present article.

[5]As the author writes in Introduction, he is especially grateful to Mikhail Volkov "for writing about the road coloring problem, the Baer radical, the Kruse–L'vov theorem, and his important contributions to several other sections of the book". (A similar gratitude is addressed also to Victor Guba, and the author briefly noted these two contributions on the cover and on the title-page of the book.)

a counter-example for the former will be a counter-example for the latter. Both of them had been posed at the beginning of the 1960s (the first one was explicitly noticed in 1961 in some paper) and afterwards mentioned in several publications. There were attempts to solve them made by different authors who obtained (positive) results concerning certain partial cases. So in general case they have been open for 55 years.

In connection with the assertion of the preceding sentence, it is exciting that apparently the present "have been" in it may be changed by the past "had been": the fact is that one of the young members of the seminar Shaprynskiĭ announced that he had constructed a counter-example solving these problems. By the way, his talk at the seminar, where he presented some principal ideas of his construction, took six (!) two-hours meetings in March–May, 2016. So, when the proof is carefully verified and turns out correct (we hope), one may suppose that the detailed text of a corresponding Shaprynskiĭ's paper will be many tens of pages long.

The next portion of publications being described in this section is a good deal of works of encyclopaedic character. This line was begun with the paper [32]. Later the present writer prepared a series of (41) papers on semigroups for the "Mathematical Encyclopaedia" [33]. Note that this encyclopaedia, published originally in Russian, later received rather wide spreading, since English, Spanish, and Chinese translations of it have appeared. A root paper *Semigroup* from the series mentioned was reproduced later in the "Mathematical Encyclopaedic Dictionary" [34]. The large book chapter [35] of a handbook on general algebra gives a comprehensive and detailed picture of semigroup theory (including applications to the theories of formal languages, automata, and codes) having formed by the beginning of the 1990s.

Later I made a contribution to the handbook [7] by preparing, partly with co-authors, 9 sections for Chapter "Semigroups" and 2 sections for Chapter "Universal Algebra". These are the following sections: *Ideals and Green's Relations, Bands of Semigroups, Free semigroups, Simple Semigroups, Epigroups, Periodic Semigroups, Subsemigroup Lattices* (the last one jointly with Ovsyannikov), *Varieties of Semigroups* (with Volkov), *Applications of Semigroups* (with G. F. Pilz and P. G. Trotter), *Free Algebras* (with Sukhanov), *Varieties and Quasivarieties* (with Volkov).

For the encyclopaedia [36], a team consisting of Koryakov, Shevrin, Volkov, and Zamyatin prepared 11 papers: *Code, Finite Automaton, Pushdown automaton, Variety of Rational Languages, Rational Language, Syntactic monoid* (all by Koryakov), *Formal Grammar* (by Koryakov and Zamyatin), *Formal language* (by Koryakov and Shevrin), *Asynchronous Automaton and Trace Theory* (both by Volkov), *and Pseudovariety of Universal Algebras* (by Volkov and Shevrin).

A certain attention was given also to scientific-popular papers devoted to some interesting mathematical, especially algebraic, topics. The first experience in this direction was my paper *On periodic and locally finite groups and semigroups* (1979) published in the pamphlet "Methodical Recommendations and Instructions on Specialization" addressed to students-mathematicians of Ural State University. Later I published three papers in the "Soros Educational Journal": *Identities in algebra* (1996), *What a semigroup is* (1997), *How groups appear when studying semigroups* (1997). The first of them has been reproduced in volume 3 of the encyclopaedia [37] prepared by the International Soros Science Education Program. Koryakov and Volkov have written some papers published in the journal for schoolchildren "MIF" (this abbreviation is derived from Russian "Matematika, Informatika i Fizika" — Mathematics, Informatics, and Physics) issued during several years by a special school (Lyceum) attached to Ural State University. It is worth especially noting the paper *The finite basis problem for identities* by Volkov (1997); the problem figuring in this title was mentioned above in Section 2. Lastly, I mention my paper *The aestheticism of mathematics* addressed to a broad circle of readers and published in the journal "Izvestiya Ural'skogo gosudarstvennogo universiteta", No. 4 (1995).

All senior members of the seminar are university teachers, so some of them succeeded in writing

teaching books for students. The most activity in this affair was manifested by Baransky, Ovsyannikov, Perminov, (V. V.) Rasin, Repnitskiĭ, Shur, Sizyi, Vernikov, and Zamyatin. There are over 50 such teaching books and methodical brochures written by different members of the seminar. They concern diverse subjects pertaining to both general and special courses: linear algebra, general algebra, geometry, number theory, mathematical logic, theory of algorithms, graph theory, theory of varieties, etc. Not giving any long list of such books and brochures, I mention here only several especially notable samples of textbooks.

The book [38] gives a good contemporary exposition of basic topics in graph theory as well as presents a detailed discussion of combinatorial algorithms solving optimization problems that arise frequently in applications. A revised edition of this book (in particular, with a number of simplified proofs) was printed by the Publishers Lan' (Fallow-deer) in 2010. The book [39], having joined especially many contributors from the seminar, covers all basic subjects of the corresponding courses and provides a rich choice of problems of different levels. The book [40] is the first textbook on this topic written in Russian. Its main content is devoted to consideration of combinatorial problems connected with the important notions "periodicity" and "unavoidability"; some combinatorial characteristics of formal languages are considered as well. The book [41] gives a systematic presentation of a number of important parts of the theory of formal languages and applications of this theory to the construction of compilers. The books [42] and [43], giving fundamentals of the corresponding mathematical disciplines, are characterized by a number of interesting peculiarities, in particular, by a lively style of presentation. The book [44], besides fundamentals of general algebra, presents different examples of its applications to such topics as binary codes (there is a corresponding separate section in the book), Boolean functions (a separate chapter), finite automata and regular languages (a separate chapter).

Another line of our activities concerns school mathematics. There are over 30 books and brochures for schoolchildren (or, partly, for school teachers) written by some members of the seminar. It would be hardly expediently to describe this line in detail within the present article; I will characterize apparently the most notable our work in this field. This is the book "*Mathematics 5–6. Textbook-Interlocutor*" created by a team headed by the present writer whose co-authors were Gein, Koryakov, and Volkov[6]. A manuscript of this textbook was awarded at the All-Union Competition in 1987 and was published in 1989. Subsequently the separate editions of the books *Mathematics 5* and *Mathematics 6* (that is, textbooks for the 5th and the 6th class, respectively) appeared in 1992–2004: four editions in Russian, one edition in Belorussian. Further, two editions of the Working Copy-Books attached to these textbooks as well as one edition of a book of methodical recommendations "*Mathematics 5. Book for Teacher*" were published. So there was, as it is customary to speak, a teaching-methodical complete set consisting of the books mentioned.

One may note in addition that the literary activities of the present writer in mathematics included also, since 1969, three teaching-belletristic books, jointly with V. G. Zhitomirsky, addressed to small children, in particular, under school age[7].

Yet another important line of our scientific publications concerns Russian translations of sev-

[6]A. G. Gein, originally a specialist on Lie algebras, formally does not belong to the scientific school led by the present writer, but he is closely connected with the seminar, repeatedly attended its meetings and gave several talks there in different years. Many years ago he as a student attended my lectures on general algebra and some special seminars, and since the 1986 he became the main co-author of mine in creation of our textbook together with all the works adjacent to it. Later he wrote quite a number of significant works devoted to school informatics and in 2000 defended a dissertation for a scientific degree "Doctor of Pedagogic Sciences".

[7]These are *Geometry for Kids*, *Mathematical ABC*, and *Travels in Geometry Land*; the last one is a considerably enlarged version of the first book. These books had in all 12 editions in Russian and 26 editions in 20 other languages.

eral books by foreign authors. These are the books [43]–[47]. This choice is explained by both our mathematical interests and a role of these books in the corresponding fields of science. The monograph [43], being, as already was mentioned in Section 2, one of the pioneering monographs on semigroup theory, is a classical work in this field of algebra, so it was very important to have this monograph in Russian. Importance of the book [44] (appeared in English in 1979) is caused by the fact that this is practically the first summarizing work treating applications of semigroups to the theories of automata, formal languages and codes in a consecutive and fundamental manner; by the way, it did not lose its significance up to now. The book [45] (appeared in English for the first time in 1984) is one of the first teaching books treating diverse applications of general algebra. Note that monographs [43] and [44] combine traits inherent in both a reference book and a teaching book, and, for instance, at Ural State University, we used them in a teaching process for lectures and special seminars. The book [46] (appeared in English in 1998) is the first monograph devoted to DNA computing, it opens quite a new trend on a junction of computer science and molecular biology. The book [47] devoted to very actual area is a professional and interactive tutorial.

6. Participation in conferences

As it follows from a remark at the beginning of Section 5 mentioning many hundreds of abstracts of talks at various conferences, the members of the seminar took part in numerous (definitely over 350) conferences, symposia, workshops, schools, etc. It is worth, first of all, mentioning among them All-Union Algebraic Conferences which were the most considerable meetings of Soviet algebraists for a long while. They were held regularly till 1991 in different algebraic centers of the Soviet Union and gathered up to several hundreds of participants. The first three such conferences were mentioned in Section 1. My students began to take part in All-Union Conferences from the 8th one, which was held in 1967; I participated in the preceding ones as well. Perhaps it is not without interest for the reader to learn a list of all these conferences.

Here is this list: I – Moscow, 1958; II – Moscow, 1959; III – Sverdlovsk, 1960; IV – Kiev, 1962; V – Novosibirsk, 1963; VI – Minsk, 1964; VII – Kishinev, 1965; VIII – Riga, 1967; IX – Gomel, 1968; X – Novosibirsk, 1969; XI – Kishinev, 1971; XII – Sverdlovsk, 1973; XIII – Gomel, 1975; XIV – Novosibirsk, 1977; XV – Krasnoyarsk, 1979; XVI – Leningrad,1981; XVII – Minsk, 1983; XVIII – Kishinev, 1985; XIX – Lvov, 1987; XX – Novosibirsk, 1989; XXI – Barnaul, 1991.

It should be noted that the last two conferences were in fact international; they were dedicated, respectively, to the 80th birthday of Academician A. I. Mal'cev (1909–1967) and to the 70th birthday of Corresponding Member of the Academy of Sciences of USSR A. I. Shirshov (1921–1981).

Almost every year certain conferences of All-Russian or regional status are attended by some representatives of the seminar. But there were very many international conferences, both in Russia and in foreign countries, which members of the seminar participated in. The leader of the seminar began to participate in conferences abroad in 1967. It was 1981 when I for the first time came to such a conference together with several of my students (Baransky, Martynov, Sukhanov, Trakhtman, and Vazhenin), it happened at the International Conference on Semigroup Theory in Szeged; I was a member of the Organizing Committee of that conference. Since the 1980s my disciples took part with increasing activity in various mathematical meetings abroad, and many members of the seminar visited on this occasion the following countries (quite a number of them repeatedly): Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Czechoslovakia (since the beginning of the 1990s — separately the Czech Republic and Slovakia), Denmark, Estonia, Finland, France, Germany, Great Britain, Hong Kong, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Latvia, Mexico, Netherlands, Poland, Portugal, Romania, Serbia, Spain, Sweden, Ukraine, the USA. Such a list can be somewhat extended if one takes into account conferences attended by the former members of the seminar who work abroad now.

Obviously it would not be reasonable to give here a list of all conferences with our participation. I remark only that in the 21st century the seminar was represented, as a rule, at more than 10 international conferences every year, and I give as an illustration the corresponding data for the year 2003. The titles of a majority of the conferences listed there show in addition some components of the spectrum of our research at the beginning of the century.

The 7th International Conference "Developments in Language Theory", Szeged, Hungary, — a speaker Ananichev;

International Conference "Lattices, Universal Algebra, and Applications", Lisbon, Portugal, the 18th IEEE Symposium on Logic in Computer Science, Ottawa, Canada, the 18th International Joint Conference on Artificial Intelligence, Acapulco, Mexico, International Seminar "Graph Coloring", Castle Dagstuhl, Germany, and the 44th Annual IEEE Symposium on Foundations of Computer Science, Cambridge, USA, — a speaker Bulatov;

International Conference "Kolmogorov and Contemporary Mathematics", Moscow, Russia, — a speaker Volkov;

International meeting on Semigroups and Related Topics, Braga, Portugal, — a member of the Program Committee Volkov;

Euresco Conference "Symmetries and Ordered Structures under the Influence of Model Theory and Combinatorics", Hattingen, Germany, — an invited speaker Volkov;

The IV International Conference on Words, Turku, Finland, — an invited speaker Volkov, speakers Ananichev and Shur;

NATO Advanced Study Institute on Structural Theory of Automata, Semigroups, and Universal Algebra, Montreal, Canada, — invited lecturers Shevrin, Volkov, and a former member of the seminar Krokhin, a speaker Semigrodskih; among the listeners there were (I. A.) Goldberg, Pleshcheva, and Vernikov;

International Conference "Mal'cev Readings", Novosibirsk, Russia, — an invited speaker Shevrin, speakers Sukhanov and Vernikov.

Thus representatives of the seminar "Algebraic Systems" participated in 12 international conferences in 2003. In 2004–2016 they attended 197 international conferences; as a rule, in each year more than 10 and sometimes more than 20 conferences were attended by representatives of the seminar. The maximum for all the preceding years was reached in 2015, namely, 29 conferences, which took place in 15 countries, among them 6 conferences in Russia.

7. Organization of conferences

For the first four decades the seminar was involved (in full or in part) in organization of several algebraic conferences. First of all, a principal role was played by it in organization of all three All-Union Symposia on Semigroup Theory held in Sverdlovsk by Ural State University (1969, 1978, and 1988); in particular, the leader of the seminar was the Chairman of the Organizing Committees of these symposia. We held also the Regional Conference of Young Scientists "Algorithms, Automata, and Semigroups" in Sverdlovsk (1982). Further, the enlarged 500th meeting of our seminar (1985) may be regarded as a conference, see some details in Section 9.

Several members of the seminar took part in organization of the XII All-Union Algebraic Conference held in Sverdlovsk (1973) as well as two International Conferences on Semigroups held in St. Petersburg (1995, 1999): Ural State University was an official co-organizer of these conferences. The former of the conferences in St. Petersburg was dedicated to the 80th birthday of E. S. Ljapin (1914–2005), the latter was held also in honor of Ljapin.

The most considerable algebraic meeting held in Ekaterinburg was the International Algebraic Conference dedicated to the centenary of the birthday of P. G. Kontorovich and to the 70th birthday of the present writer. This conference was organized by Ural State University and the Institute

of Mathematics and Mechanics of the Ural Branch of the Russian Academy of Sciences and took place from August 29 to September 3, 2005. The Organizing Committee headed by the Rector of the University V. E. Tretjakov and the Director of the Institute V. I. Berdyshev included, among the others, several representatives of the seminar: Baransky (Vice-Chairman), Popov, Repnitskiĭ, Sukhanov, Volkov (Secretary). The seminar in all (with the exception of its leader who because of a natural reason was free of any organizing duties that time) was attached to the Organizing Committee for carrying out a lot of tasks usually arising in such arrangements. The Program Committee consisted of 20 major algebraists from Russia (9 members), the USA (3 members), Germany (2 members), Austria, Belorussia, Canada, Great Britain, Hungary, and Israel (by 1 member). The seminar was represented in the Program Committee by Baransky as one of the Co-Chairmen as well as by two former members of it, Kharlampovich and Sapir.

The conference gathered about 200 participants from 23 countries. The following five sections worked: Groups, Semigroups, Rings, Universal Algebras and Lattices, and Applications. 21 plenary lectures, 15 section lectures and 93 contributed talks at the sections were given. It is interesting to note that the seminar "Algebraic Systems" celebrated a certain jubilee at the conference: one of the plenary sessions was combined just with the 1000th meeting of our seminar; see the program of that meeting in Section 9.

The next international conferences in organization of which a key role was played by some members of the seminar were devoted to computer science and the theory of formal languages. The first of them belonged to the series of annual International Computer Science Symposia in Russia (CSR). This series started in 2006 (CSR 2006) by a symposium held in St. Petersburg. Just the second one, CSR 2007, was organized in Ekaterinburg by Ural State University and took place on September 3–7, 2007. The Organizing Committee chaired by Volkov included also his students (S. V.) Goldberg, Povarov, and Pribavkina. The Program Committee consisted of 35 leading computer scientists from 13 countries and was co-chaired by V. Diekert (Germany) and A. Voronkov (Great Britain). Besides plenary meetings, two parallel sections worked: Theoretical Computer Science, Applied Computer Science and Technology.

The Symposium CSR 2007 was accompanied by three satellite events: the Workshop on Computational Complexity and Decidability in Algebra, the Workshop on Infinite Words, Automata and Dynamics, and the Russian Summer School in Information Retrieval. The total number of participants of CSR 2007 and its satellite events was about 150, including 40 foreign participants from 18 countries.

The conference proceedings were published by Springer as volume 4649 of the series "Lecture Notes in Computer Science" (the editors Diekert, Volkov, and Voronkov).

The Symposia CSR 2008 – CSR 2012 took place, respectively, in Moscow, Novosibirsk, Kazan, St. Petersburg, and Nizhny Novgorod. The 8th Symposium CSR was held again in Ekaterinburg on June 25–29, 2013; the organizers were actually the same, by this time the name of the university-organizer had been changed and became Ural Federal University: this university appeared in 2011 as a result of merger of Ural State University and Ural Technical University. The Organizing Committee of the Symposium CSR 2013 chaired by Shur included, in particular, Pribavkina and Volkov. The Program Committee chaired by Bulatov consisted of 23 renowned specialists from 12 countries. It is interesting to note that among the main speakers of the symposium there was M. Szegedy (USA), two-time winner of the Godel Prize, who gave the opening lecture.

There were three satellite events: the 2nd Workshop on Current Trends in Cryptology, the 4th Workshop on Program Semantics, Specification and Verification: Theory and Applications, and the 6th School for students and young researchers Computer Science Ekaterinburg Days, the topic of the latter was "Algorithms and Complexity". Altogether, more than 100 scientists, including 30 foreign colleagues, participated in CSR 2013 and its satellite events.

The conference proceedings appeared as volume 7913 in Springer's series "Lecture Notes in

Computer Science" (the editors Bulatov and Shur).

Another series of conferences where we were to have a role of the organizers is the series of International Conferences Developments in Language Theory (DLT). This is the main conference series in formal language theory; it was founded by the famous computer scientists G. Rozenberg and A. Salomaa in 1993. Since 2001 DLT conferences became annual, and they take place in Europe in every odd year and outside Europe in every even year. The first such conference in Russia was held in Ekaterinburg by Ural Federal University on August 26–29, 2014; this was the 18th DLT conference. (Recall that Ekaterinburg is located in Asia, so that it was quite eligible to host DLT 2014 here.) In the Organizing Committee of the Conference DLT 2014 chaired by Volkov, a key role was played by the same team as at the Symposium CSR 2013: the chairman, Pribavkina, and Shur. The Program Committee co-chaired by Shur and Volkov included 18 prominent researchers from 12 countries.

The 7th School for students and young researchers Computer Science Ekaterinburg Days with the topic "Strings, Languages, Automata" was held as a satellite event of DLT 2014. About 70 participants in the conference and the school came from 20 countries including very remote ones, such as Brazil and New Zealand.

The conference proceedings were published by Springer as volume 8613 of "Lecture Notes in Computer Science" (the editors Shur and Volkov). Note that revised and expanded versions of selected papers presented at DLT 2014 formed a special issue of the "Journal of Foundations of Computer Science" (vol. 27, No. 2 (2016)), the guest editor of which was Shur.

It should be also noted that some representatives of the seminar were included in the organizing or program committees of many other conferences, both in Soviet Union (or Russia) and abroad. This concerns first of all the present writer who took part in such committees from the end of the 1960s. For the last two decades this kind of activities is rather typical for Volkov, and in the last years the same takes place for Shur as well. I mention also Baransky who had been participating for some years in the organization of several conferences, both All-Russian and regional, devoted to topics of information security.

8. Membership in editorial boards

Since 1972 the leader of the seminar enters the Editorial Board of the journal "Izvestiya VUZ. Matematika" which is one of the central All-Russian (before 1992 — All-Union) mathematical journals. By comparison with my membership in other editorial boards, the work in this Editorial Board was the most intensive. Indeed, during 45 years I had to consider over 650 papers submitted to this journal and devoted to algebraic (or, in very rare cases, number-theoretic) subjects. As usual, it was necessary to select an appropriate referee for each of them; for more than 60 papers, I myself acted as the referee.

It is notable that from the beginning of the 1980s till 2010 there was a tradition to publish systematically separate issues of this journal entirely devoted to one or another branch of mathematics and compiled by some member of the Editorial Board. Such issues were printed with a considerably greater circulation. I compiled and edited 5 such issues devoted to topical subjects. Here is the corresponding list, where a thematic peculiarity of each issue is given: i) 1982, No. 11 – varia; ii) 1985, No. 11 – the theory of varieties of algebraic systems; iii) 1989, No. 6 – again the theory of varieties; iv) 1995, No. 1 – the theory of pseudovarieties of algebraic systems; v) 2010, No. 1 – certain connections between the theories of finite automata and formal languages. I should note that the last issue was compiled and edited by me jointly with Volkov. Among the authors of papers in all these issues, there were quite a number of mathematicians specially invited for contributing to this enterprise. In the first three issues, they are such distinguished Soviet algebraists

as Yu. A. Bakhturin, L. A. Bokut', Z. I. Borevich, A. R. Kemer, Yu. N. Mal'cev, A. V. Mikhalev, A. Yu. Ol'shanskii, L. A. Skornjakov, A. I. Starostin, and E. I. Zel'manov (future Fields medalist). In the other two issues, they are the following renowned foreign specialists in the corresponding areas of mathematics: J. Almeida, S. Margolis, J.-E. Pin, P. Weil, and, respectively, V. Diekert, T. Harju, D. Nowotka, M. Droste. The members of our seminar were represented among the authors in all these issues.

It was 1976 when I was invited to enter the Editorial Board of "Semigroup Forum", which is an international journal on the theory of semigroups printed in the USA. In 1979–1988 I was a member of the Editorial Board of "Simon Stevin", an international journal printed in Belgium. The current Editorial Board of "Semigroup Forum" contains two representatives of Russia, and both of them are members of our seminar: the present writer and Volkov who was invited in 1998 and became one of the Executive Editors since 2003. In 2010 Volkov entered the Editorial Board of "International Journal of Algebra and Computation" as well.

Now I mention the periodical editions on mathematics published by Ural State University. This is first of all "Matematicheskie zapiski" already mentioned above. After P. G. Kontorovich who was the first Editor-in-Chief since the beginning of the 1960s, the present writer carried out the same functions in 1969–1989. Since 1982 the Editorial Board of "Matematicheskie zapiski" was supplemented by Volkov, since 1987 it was supplemented by Koryakov. After a nine-year break publishing periodical mathematical editions at our University resumed with the journal "Izvestiya Ural'skogo gosudarstvennogo universiteta. Matematika i mehanika"; the Editorial Board consisted of 7 members including Shevrin as the Vice-Editor-in-Chief and Volkov as the Secretary. This journal was published till 2006. By the way, the first paper about our seminar [4] appeared just in the first issue of it. In that journal, there was a rubric "Scientific life", where we regularly published information about the meetings of our seminar.

In 2008–2010 a new series of "Izvestiya Ural'skogo gosudarstvennogo universiteta" existed, with the heading "Matematika, mehanika i informatika". Among 14 members of its Editorial Board, there were 4 representatives of our seminar: Baransky, Shevrin (one of two Vice-Editors-in-Chief), Shur, and Volkov (Secretaries).

There were some single editions that had the editorial boards entirely consisted of members of the seminar. These are mainly the materials of three All-Union Symposia on Semigroup Theory mentioned above. For each of these symposia, we prepared a collection of abstracts of talks at this symposium. Here are the Editorial Boards for these collections, everywhere with Shevrin as the Editor-in-Chief: for the 1st Symposium, Golubov, Shevrin, and Vazhenin; for the 2nd Symposium, Baransky, Golubov, Shevrin, Vazhenin, and Zamyatin; for the 3rd Symposium, Baransky, Golubov, Shevrin, Sukhanov, Vazhenin, Volkov, and Zamyatin. At the 2nd Symposium, a separate pamphlet with abstracts of plenary lectures was also printed (edited by Shevrin).

Another our useful publication was closely connected with the symposia mentioned. After each of them we prepared a collection of unsolved problems in semigroup theory. Some of them were posed directly at the symposium, mostly at a special session devoted to open problems; some problems were sent by their authors later, among such authors there were not only those ones who attended the symposium. For the first collection, a part of problems was taken also from a notebook started in 1965 by the present writer who proposed personally some semigroupists to write down open problems in this notebook for a subsequent publication somewhere. (It is so notable that Prof. A. H. Clifford (1908–1992), a patriarch in semigroup theory, was among the first ones who contributed to this collection. I first met him in 1966 at the International Congress of Mathematicians in Moscow.) The collection mentioned was entitled "Sverdlovsk Tetrad" (Sverdlovsk notebook) and published as a pamphlet, which afterwards was distributed among algebraists interested in semigroup theory. Thus there were three editions of "Sverdlovsk Tetrad" (1969, 1979, and 1989). Here are the Editorial Boards of them, with the same Editor-in-Chief as for the collections

of abstracts at the symposia: for the 1st edition, Shevrin, Vazhenin; for the 2nd one, Baransky, Golubov, Shevrin, and Vazhenin; for the 3rd one, Baransky, Golubov, Shevrin, and Volkov. There is English translation of the 1st edition, which was revised by omitting some of the problems (as a rule, those ones which were solved by that time), see [48]. In each of the subsequent editions there was a special section with comments concerning problems from the previous edition(s) that had been (completely or partially) solved by that time.

The Editorial Board of the collection of abstracts at the International Algebraic Conference held in Ekaterinburg in 2005 consisted of four persons, two of which are members of our seminar: Ovsyannikov and Vernikov (Editor-in-Chief). I remark also that two present members of the seminar and one former member were mentioned in Section 7 as the editors of the materials relating to the international conferences CSR 2007, CSR 2013, and DLT 2014 characterized in that section.

I add yet that the Editorial Board of the journal "MIF" mentioned in Section 5 included two representatives of the seminar: Rasin (Editor-in-Chief) and Volkov.

Lastly, I would like to note that some former members of the seminar working abroad were invited to enter the editorial boards of several journals: Kharlampovich — in "International Journal of Algebra and Computation", since 1997; Krokhin — in "Multiple-Valued Logic", 1999–2002; Sapir — in "Algebra Universalis", 1999–2004, "International Journal of Algebra and Computation", 2000–2015 (since 2010 Managing Editor), "Algebra and Discrete Mathematics", since 2003, as well as "Algebra and Combinatorics" (book series), since 2001.

9. Meetings and speakers

The first meeting of the seminar took place on November 2, 1966; so the 50th anniversary of our work was celebrated in November, 2016. Usually we hold about 25 meetings per year; by the anniversary mentioned 1246 meetings had been held. At each meeting, we, as a rule, listen and discuss one talk of duration either about 2 hours (with a break) or a "long" hour; sometimes there may be two shorter talks or, very rarely, a greater number of reports. On the other hand, separate talks may take 2–3 meetings; talks of such duration were rather frequent during the first years of the work of our seminar. The record of the duration of a talk (6 meetings) was mentioned in Section 8.

As was mentioned in the previous section, information about the meetings of our seminar was regularly published in the journal "Izvestiya Ural'skogo gosudarstvennogo universiteta. Matematika i mehanika" during the period of its existence (1998–2005). More concretely, this was done in issues 1–4 and 6–8 of this journal and embraced the meetings from the 800th one to the 1000th one. The corresponding reports were devoted to each meeting separately, they indicated its number and the date, often included the abstracts of talks, which usually were rather informative (not infrequently with the formulations of theorems and, if necessary, even with required definitions). By the by, abstracts of the foreign speakers were given in English.

There is a diary of the seminar which is kept by the secretary of the seminar. I should remember Vazhenin (1945–2003) who was the permanent secretary from the very beginning of our work up to his last days. After him Popov was the secretary for 4 years, and then Shur changed him in this job. From the diary we can derive statistics we would like to know. Every hundredth meeting has a special program: we sum up some statistics, discuss both certain results of the period passed and possible prospects of research for forthcoming years. Four meetings of the seminar were enlarged; information about them is given in the next paragraphs.

The 300th meeting took place on June 30, 1978, just after the 2nd All-Union Symposium on Semigroup Theory mentioned in section 7, and many participants in that symposium attended this meeting. The 415th meeting took place on June 30, 1982, and it was combined with a session of

the Regional Conference "Algorithms, Automata, and Semigroups" also mentioned in section 7.

The 500th meeting was especially considerable: nominally one meeting, in reality it was divided into five long sessions held during three days, from January 31 to February 2, 1985. This meeting in essence turned into a peculiar All-Union conference, it gathered over 90 participants from 20 towns of the Soviet Union and had 38 speakers.

The 1000th meeting took place on September 1, 2005, and was continuing the whole day. As was mentioned in Section 7, it was combined with one of the plenary sessions of the International Algebraic Conference, so it gathered many algebraists from different countries. Here is the program of this jubilee meeting.

L. N. Shevrin (Ekaterinburg), *The seminar "Algebraic Systems" by the 1000th meeting.*

O. G. Kharlampovich (Montreal), *Decidability of the elementary theory of the free group.*

V. Yu. Popov (Ekaterinburg), *Status and diameter of semigroups.*

A. A. Bulatov (Vancouver), *Local methods in CSPs.*

L. Márki (Budapest), *Universal aspects of general radical theory.*

F. Pastijn (Milwaukee), *The lattice of varieties of idempotent semirings.*

A. M. Shur (Ekaterinburg), *On complexity of formal languages.*

R. Pöschel (Dresden), *Completeness and rigidity for operations and relations.*

As the reader can see, among the speakers at this meeting, besides the leader of the seminar, there were two of its current participants and two former members who came from Montreal and Vancouver. The other speakers belong to the group of our foreign colleagues who visited us before and gave their talks at the seminar in different years. For instance, L. Márki was just the first foreign speaker at our seminar and first gave his talk at the seminar on August 29, 1989.

When we were planning the 1200th meeting, which took place on December 4, 2014, a certain summarizing statistics had been prepared. Here are several principal details of this statistics. By that date there had been 301 speakers in all at the seminar who gave 1673 talks or reports. The set of speakers has the following partition into three groups: a) 135 speakers from Ekaterinburg (Sverdlovsk) including those ones who work in other towns now, in particular, abroad (some of them repeatedly visited the seminar by coming to Ekaterinburg for several days from the place of their current stay); b) 145 speakers from 48 other towns of the former Soviet Union; c) 21 speakers properly from 15 foreign countries, namely, from Australia, Austria, Canada, China, the Czech Republic, France, Germany, Great Britain, Hungary, India, Italy, Poland, Portugal, Spain, the USA.

The speakers from Ekaterinburg have given 1362 talks (or, sometimes, shorter reports), the speakers from the other two groups have given, respectively, 280 and 31 talks. Naturally, now all mentioned numbers have increased in due course.

For each town represented by at least one speaker at our seminar, we know the set of all such speakers and the number of talks given by every of them. As to Ekaterinburg, the total quantity of speakers and the total number of talks (reports) given by them are shown above. I show similar numbers for several towns from an upper part of the list of other towns (in brackets, the number of the corresponding talks is given): Novosibirsk – 19 (39), Moscow – 18 (28), Leningrad (later St. Petersburg) – 11 (14), Omsk – 10 (29), Saratov – 10 (20). It is interesting to notice that, as one easily can deduce, the speakers from these five towns form about a half of the whole set of speakers from 48 towns of the second mentioned group, and the total number of talks given by them is approximately in the same relation to the corresponding quantity 280 talks.

As to the regular members of the seminar, I give in the next paragraph an upper part (ten places) of a list of the most productive speakers and show the number of the talks given by each of the mentioned persons by the 1200th meeting, i. e., by December, 2014.

Volkov – 107; *Vazhenin* – 75, the second place for him may be considered as surprising, because he passed away 14 years ago, but during the first decades of our work he permanently was the

most active speaker at the seminar; *Shevrin* – 72; *Sapir* – 66, which is surprising, since he left Ekaterinburg in 1990 and visited us only once afterwards (in 1990 he was the second one in the list under consideration); *Vernikov* – 60; *Kharlampovich* – 58, which may seem surprising, since she left Ekaterinburg in 1990, but in reality she visits the native city every year (sometimes twice) and always gives a talk at the seminar; *Baransky* – 50; *Repnitskiĭ* – 46; *Popov* – 46; *Golubov* – 44.

In a similar list of the foreign speakers at the seminar, the first place is occupied by *L. Márki* (Budapest), *F. Pastijn* (Milwaukee), *R. Pöschel* (Dresden), and *J. Tůma* (Prague) — by 3 talks.

Quite a number of my scientific disciples have been or had been the regular members of the seminar for several decades, giving talks, participating in discussions, and contributing to creation of a propitious atmosphere at our meetings. I would like to list here those of them who are connected with the seminar for many years and continue their regular participation in its work up to now; for each one, I indicate the year when he/she began attending the meetings of the seminar. They are *Vitaly Baransky* (since the first meeting, 1966), *Mikhail Volkov* (since 1973), *Vladimir Repnitskiĭ* (since 1974), *Alexander Ovsyannikov* (since 1975), *Eugene Perminov* (since 1977), *Boris Vernikov* (since 1980), *Dmitry Ananichev* (since 1991), *Olga Finogenova* (since 1992), *Arseny Shur* (since 1993). It may be said that these mathematicians, together with the present writer, form a current core of the seminar. One may regard Olga Kharlampovich as a person adjacent to this core. She began attending the seminar in 1978, and, as it was noted above, although she left Ekaterinburg more than quarter a century ago, she visits us every year and belongs to the most productive speakers at the seminar.

With warm feelings I also remember my talented and active students passed away for the last 14 years: *Yuri Vazhenin, Alexei Zamyatin, Igor Koryakov, Veniamin Rasin, Eugene Sukhanov.* The reader can observe that their names repeatedly appear in the text of this article including the list of references.

10. Concluding remarks

Viability of a scientific collective for a long time and its stability depend on many factors. Not discussing in detail this theme here, I want only to remark that one of such factors is more or less regular replenishment of the corresponding group with younger researches. Applied to the seminar under discussion, it was a matter of my permanent care. And there are reasons to be satisfied that several of my scientific children and grandchildren now continue this line and successfully train some representatives of a further generation for research work; a confirmation of this assertion can be seen in Section 3 and in some parts of Section 4. This is promoted, in particular, by means of organizing certain "subseminars". More than 20 years ago Baransky, Vazhenin, and Sukhanov organized, respectively, their seminars on combinatorics, algorithmic problems of algebra, and discrete mathematics. At present Baransky leads the seminar "Algorithms and Combinatorics", Volkov and Ananichev lead the seminar "Computer Science", Popov leads the seminar "Intelligent Systems", Shur leads the seminar "Discrete Mathematics".

Now representatives of four scientific generations may take part at a meeting of the seminar "Algebraic Systems". One may hope that various participants in the seminar will successfully continue their investigations both in topics that have become traditional for the seminar and in new topics being assimilated at present.

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